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The Support Leader's Digital Assistant

OPERATIONS RESEARCH CENTER OF EXCELLENCE
TECHNICAL REPORT DSE-TR-0510
DTIC #: ADA436574

Lead Analyst
Major Wiley P. Rittenhouse, M.S.
Analyst, Operations Research Center

Analyst
Major Holly F. West, M.B.A.
Assistant Professor, Department of Systems Engineering

Analyst
Major Elizabeth W. Schott, M.S.
Analyst, TRAC - White Sands Missile Range

Senior Investigator
Lieutenant Colonel Michael J. Kwinn, Jr., Ph.D.
Director, Operations Research Center of Excellence

Approved by
Colonel Michael L. McGinnis, Ph.D.
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Abstract

Currently, there is no standard tool designed to assist Army maneuver battalions in daily forecasting of food, water, petroleum products, and ammunition. Support platoon leaders and battalion logistics officers forecast logistical requirements primarily by hand or with tools developed "in-house". Because these personnel do not get the training needed to do accurate forecasting, they typically seek the assistance of Forward Support Battalion (FSB) company commanders through informal channels. The goal is to achieve the most accurate supply forecast possible, but under the current system, over-forecasting or under-forecasting is common, which can result in unnecessary risk to the mission, units, or support personnel, as well as increasing stress on the logistics chain. Currently, the only automated tools available are designed for brigade level and above.

The Support Leader's Digital Assistant (SLDA) began as an Excel spreadsheet designed to forecast re-supply needs based on existing planning figures, and was subsequently developed for the Palm platform as a test of concept. The goal of this phase of development was to expand its forecasting capabilities, adjust the model's parameters to interface with existing, higher echelon automated systems, and to facilitate its development for the PocketPC platform.

About the Author(s)

MAJOR WILEY P. RITTENHOUSE is an instructor in the Department of Mathematics serving as an analyst in the Operations Research Center of Excellence at the United States Military Academy (USMA), West Point, New York. He received a BS in Mathematics from Kansas State University in 1994 and a MS in Statistics from Tulane University in 2003. His research interests include the application of statistical analyses and simulation to operations research. His email address is Wiley.Rittenhouse@usma.edu.

MAJOR ELIZABETH W. SCHOTT is assigned to the Army Training and Doctrine Command Analysis Center-White Sands Missile Range, New Mexico. She has a bachelor's degree in mathematics from the USMA and a master's degree in industrial engineering from the Georgia Institute of Technology. She is a graduate of the Quartermaster Officer Basic Course, the Combined Logistics Officers Advanced Course, and the Army Command and General Staff Officer's Course. Her e-mail address is Elizabeth.Achott@us.army.mil.

MAJOR HOLLY F. WEST is an assistant professor of systems engineering at the U.S. Military Academy (USMA). She has a bachelor's degree in economics from the USMA and a master's degree in business administration from the University of Kentucky. She is a graduate of the Quartermaster Officer Basic Course and the Combined Logistics Officers Advanced Course. Her e-mail address is Holly.West@usaac.army.mil.

LIEUTENANT COLONEL MICHAEL J. KWINN, JR., is an Associate Professor in the Department of Systems Engineering and Director of the Operations Research Center of Excellence at the United States Military Academy, West Point. He has a B.S. Degree from USMA, M.S. degree in Systems and Industrial Engineering from the University of Arizona and a Ph.D. in Management Science and Information Systems from the University of Texas, Austin. His research interests include operational assessment methodology, efficiency analysis, recruiting analysis especially marketing effects and capability analysis and modeling. Lieutenant Colonel Kwinn may be contacted at Michael.Kwinn@usma.edu.

Acknowledgements

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Chapter 1:   Introduction

1.1. Background.

The SLDA concept is based on the work of MAJ Holly West and MAJ Libby Schott (West, Schott, Army Logistician, July-August 2005) with the initial prototype developed by Dr. Roy Boggs from Florida Gulf Coast University in 2002. In its second stage, the project was presented as the Requirements Analyzer (REA) (West, Schott, MORSS, 2004) which culminated in a second prototype written for the Palm platform by MAJ Jim Jackson (Department of Electrical Engineering and Computer Science, U.S. Military Academy, West Point). The authors also visited personnel at the 3rd Stryker Brigade Combat Team at Fort Wainwright, Alaska to present the concept to them and solicit their input.

1.2. Purpose.

This document provides the software requirements specification (SRS) for the Support Leader's Digital Assistant (SLDA), version 1. The SLDA is to be a tool available to leaders in lower-echelon combat units who are responsible for logistics operations. It should accept and store information on unit personnel and equipment, climate, ration requirements, mission data, equipment status, mission-oriented protective posture (MOPP), on-hand supply data, and date/time. It should generate forecasts for (primarily) Class I (rations and water), Class III (petroleum products, both bulk and packaged), and Class V (ammunition) supplies as well as (secondary) certain critical Class II (individual equipment) items and Class IV (construction and barrier materials). Finally, it should generate requisition data, reports, and keep a history of forecasts and requisitions. The purpose of this document is to describe the SLDA from an overall point of view, describing how it should be used, how it should behave, its operating environment, and its limitations.

1.3. Document Conventions.

Many of the diagrams in this document are shown in Appendix A, due to their large size.

1.4. Intended Audience and Reading Suggestions.

The primary intended audience for this document is the developer hired under contract with the Program Manager, Logistics Information Systems (PM-LIS) so as to facilitate the application's development for the PocketPC platform.

1.5. Scope of the Development Project.

Many of the details regarding the objectives and benefits, as well as some of the features of the SLDA are already explained in the paper "The Support Leader's Digital Assistant: A Tool for the Support Platoon Leader" (Rittenhouse, Kwinn, West, 2005). The logistical forecasts in the SLDA are derived initially from published planning values (Edwards, 2000) for the different classes of supply. However, as the SLDA acquires historical data from repeated forecasts, it should utilize the data to determine a forecast based on actual consumption history.

1.6. Overview of Document.

Chapter 2 provides an overall description of the SLDA, along with its functions and data requirements. Chapter 3 briefly discusses external interface requirements. Chapter 4 discusses system features in detail. Equations, large diagrams, references, and a list of abbreviations can be found in the appendices.

Chapter 2: Overall Description.

2.1. Product Perspective.

The SLDA is intended to provide leaders in combat units a means of determining accurate supply forecasts without having to rely on outside assistance. Personnel in lower-echelon units (battalion and below) who are responsible for support operations are usually not trained logisticians, and they will typically need to seek outside assistance to determine an accurate forecast. This is not always possible due to the tactical situation. The SLDA is meant to provide these leaders with "in-hand" expertise for forecasting their support needs, and to provide tools to make the most accurate forecasts possible from available data. The SLDA is essentially a new product – it has been developed in limited form to test the concept, but the intent of this document (together with the SDS) is to provide requirements and design specifications necessary to develop a deployable solution, ready to put into the hand of the Army's combat unit support leaders. Ultimately, the SLDA should become an integrated part of the Army's supply chain management system. A basic application structure is shown in Figure 1.
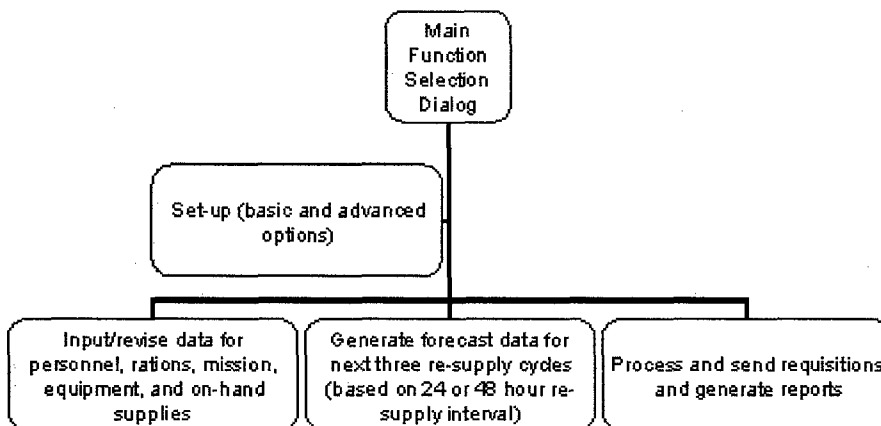
Figure 1: SLDA Overall Structure

2.2. Product Functions.

The SLDA's functional hierarchy is given in Appendix B.

2.3. User Classes and Characteristics.

The primary user class for the SLDA is the lower-echelon combat unit support officer, usually the support platoon leader, the battalion S4, or the SPO. It is assumed that this class of user has no formal logistics training.

2.4. Operating Environment.

The SLDA is to be developed for use on the PocketPC platform.

2.5. Assumptions and Dependencies.

It is assumed that the application's requisition data will be passed on to outside organizations using an external application, so the SLDA should only need to produce the necessary requisition data as an object that can be acted upon by a separate application. It is also assumed that the SLDA will not receive personnel or maintenance data electronically from other systems. The quality of many of the inputs is dependent on the user receiving and aggregating good data from within the unit.

2.6. Overview of Data Requirements.

2.6.1. Inputs.

Table 1 describes data input requirements. If a main input also includes sub-inputs, they are listed after it (indicated in the center column).

Table 1: Data Input Requirements

Main Input	Sub-Input	Description
Unit Information		This will be simply a text entry recording the unit name and type.
Personnel Data		The user will be allowed to enter personnel count values for each 24-hour period that falls within the next three re-supply periods (i.e. if the re-supply interval is 24 hours, there will be personnel counts for 24, 48, and 72 hours. If the re-supply interval is 48 hours, there will be counts for 24, 48, 72, 96, 120, and 144 hours). The user will indicate the number people with special meal requirements (by type) for each 24-hour interval, as well as total unit count.

Main Input	Sub-Input	Description
Climate		The user will select the appropriate climate type for each re-supply interval (hot/arid, hot/tropical, temperate, or cold).
Equipment		User will select number of vehicles by type from a general list. Vehicle types with a count of zero entered will not be visible outside the set-up dialog.
Ration Cycles		User will select the three-character ration cycle for each 24-hour period that falls within the next three re-supply periods.
Mission Data		This data is entered into a dynamic list. The main index is time and is only entered in whole hours. A new entry is created only if one of the following elements changes (all elements plus time are given in each list entry).
	Mission Type	offensive, defensive, or movement
	Mission Terrain	cross-country, road, or idle
	MOPP Level	0, I-IV, or unknown
Equipment Status		
	Deadlined Equipment	The user should be able to enter the number of deadlined vehicles or systems by type.
	On-Hand Supplies	The user should be able to enter on-hand quantities for MREs, water (bulk and bottled), fuel (by type), package POL, and ammunition (by type).

2.6.2. Outputs.

Table 2 describes data output requirements. If a main input also includes sub-inputs, they are listed after it (indicated in the center column).

Table 2: Data Output Requirements

Main Output	Sub-Output	Description
Forecasts		Forecasts are generated for the next three re-supply operations (for planning purposes).
	Class I Forecast	MREs (by case and by meal), Hot A (by meal), UGR (by meal), water (bulk and bottled).
	Class III Forecast	Bulk fuel (by type) and package POL (by type).

Main Output	Sub-Output	Description
	Class V Forecast	Ammunition (by type).
Requisitions		For Classes I, III and V, only generated once for each re-supply operation (not for each forecast interval).
Reports		Generate reports for the next higher echelon, for the SPO, and to show historical data.

2.6.3. Stored Data.

There will be several tables of source data that will be called upon to facilitate data input and forecasting. They are listed in Table 3.

Table 3: Source Data Tables

Table	Description
Vehicle Data	Includes type, fuel type, fuel capacity, fuel consumption rates, and any mounted weapons integral to the system.
Weapons Data	Includes type and ammunition requirements.
Ammunition Data	Includes DODIC, description, and round count per container.
Planning Values	For Class I, III and V (used for early forecasting before accumulated historical data can be used).

2.7. User View of Product Use.

The primary user would employ the SLDA to assist in completing the unit's daily LOGPAC.

Chapter 3:   External Interface Requirements.

3.1. User Interfaces.

The primary interface with the SLDA should be the screen interface of the PocketPC device. Because of this, entry of raw data (numeric or text) should be minimized by making use of pull-down menus (for short lists of options) or "spinners" (for longer lists, usually numeric) whenever possible.

3.2. Hardware Interfaces.

Determined by PM-LIS/TLDD

3.3. Software Interfaces.

Determined by PM-LIS/TLDD

3.4. Communications Interfaces.

Determined by PM-LIS/TLDD

Chapter 4: System Features.

4.1. The Main Function Selection Dialog (MFSD).

This should be the application's top level, providing direct access to all primary functions.

4.1.1. Description.

This dialog presents the user with buttons that provide access to the following sub-functions: SLDA Set-Up Dialog, Class I Forecasting Dialog, Class III Forecasting Dialog, Class V Forecasting Dialog, Requisition & Report Generation Dialog, and Exit the Application.

4.1.2. Stimulus/Response Sequences.

When the user clicks any one of the buttons in this dialog, the top-level or entry dialog for the associated sub-function should appear. When all processes for the sub-function are completed, the user should be presented with an exit button that will return the SLDA to the MFSD.

4.2. The SLDA Set-Up Dialog.

4.2.1. Description.

This dialog allows the user to enter or select data that is needed for supply forecasting. Most of the data entered here will not need to be changed frequently. The top level in this dialog is a panel of user-selectable buttons that give the user access to dialogs for "Unit Information", "Equipment Data", Basic Load Data", and "Planning Values". Once the user has completed the steps in this dialog, the "Unit Equipment Table" will be populated with equipment data based on built-in default information. This table will be available for modification in the "Equipment Data" dialog.

4.2.2. Stimulus/Response Sequences.

4.2.2.1. Unit Information.

This dialog consists of five sub-dialogs that are linked in sequence, with "next", "back", and "finished" buttons to allow the user to navigate through the sequence. Once the user selects "finished" on the final sub-dialog, the program returns to the top level in the SLDA Set-Up Dialog.

4.2.2.1.1. Unit Name.

Stored as text. This information is referenced for report titles. A "next" button should take the user to the "Unit Type" dialog.

4.2.2.1.2. Unit Type.

Selected from a list of options (version 1: infantry or armor battalion), which sets the appropriate flag indicating unit type. The flag value will be used to filter out unneeded vehicle information stored in the Equipment Data Table. The intent of this is to quickly create a "pre-built" list of vehicle types and quantities based on default information (actually done in three steps using the "Unit Type", "Task Organization", and "Attachments & Detachments" sub-dialogs) and representing a complete table of assigned vehicles. A "next" button should take the user to the "Task Organization" dialog. A "back" button should return the user to the "Unit Name" dialog.

4.2.2.1.3. Task Organization.

User selects the number of each type of company-sized unit in the battalion from a pull-down list. Selected values are used to determine the quantity of each type of vehicle based on default values for company-sized units. These values are used to add vehicle counts to the list of equipment that results from the "Unit Type" dialog. A "next" button should take the user to the "Attachments & Detachments" dialog. A "back" button should return the user to the "Unit Type" dialog.

4.2.2.1.4. Attachments & Detachments.

User selects the number of each type of company or platoon sized units that are attached to the battalion from pull-down lists. Selected values are used to further modify the quantities for equipment types that resulted from the "Task Organization" dialog. A "next" button should take the user to the "Re-Supply Interval" dialog. A "back" button should return the user to the "Task Organization" dialog.

4.2.2.1.5. Re-Supply Interval.

User selects from two "radio buttons" the re-supply interval that the unit uses. Radio button options should be "24 hours" or "48 hours". A flag is set depending on the selection made. This flag will be used in forecasting calculations. A "finished" button should take the user to the top-

level dialog. A "back" button should return the user to the "Attachments & Detachments" dialog.

4.2.2.2.   Equipment Data.

This dialog consists of two main dialogs with one sub-dialog each that are linked in sequence, with "next", "back", and "finished" buttons to allow the user to navigate through the sequence. Once the user selects "finished" on the final dialog or sub-dialog, the program returns to the top level in the SLDA Set-Up Dialog. These dialogs are intended to allow the user to make adjustments and additions to the pre-populated table resulting from the dialogs described in sections 4.2.2.1.2, 4.2.2.1.3, and 4.2.2.1.4.

4.2.2.2.1.   Adjust Vehicle Quantities.

This dialog calls up the data stored in the "Unit Equipment Table" and allows the user to directly edit the quantities for each vehicle type. Any changes should be stored back in the "Unit Equipment Table". The data should be presented in tabular form. A button marked "Enter additional vehicles & quantities" should take the user to the "Enter Additional Vehicles & Quantities" sub-dialog. A "next" button should take the user to the "Adjust Weapon Quantities" dialog.

4.2.2.2.1.1.   Enter Additional Vehicles & Quantities.

This sub-dialog should have the same appearance as the "Adjust Vehicle Quantities" dialog. The primary difference from the parent dialog is that the user should be able to select from a pull-down list of vehicles (stored in the "Equipment Data Table") any vehicle types that are not currently listed in the "Unit Equipment Table" as a result of completing the "Unit Information" dialog. The user should then be able to enter quantities next to any new vehicle type entries. Any changes should be stored back in the "Unit Equipment Table". A "next" button should take the user to the "Adjust Weapon Quantities" dialog.

4.2.2.2.2.   Adjust Weapon Quantities.

This dialog also calls up the data stored in the "Unit Equipment Table" and allows the user to directly edit the quantities for each weapon type. Any changes should be stored back in the "Unit Equipment Table". The data should be presented in tabular form. A button marked "Enter

additional weapons & quantities" should take the user to the "Enter Additional Weapons & Quantities" sub-dialog. A "finished" button should take the user back to the top level dialog.

4.2.2.2.2.1. Enter Additional Weapons & Quantities.

This sub-dialog should have the same appearance as the "Adjust Weapons Quantities" dialog. The primary difference from the parent dialog is that the user should be able to select from a pull-down list of vehicles (stored in the "Equipment Data Table") any weapon types that are not currently listed in the "Unit Equipment Table" as a result of completing the "Unit Information" dialog. The user should then be able to enter quantities next to any new weapon type entries. Any changes should be stored back in the "Unit Equipment Table". A "finished" button should take the user back to the top level dialog.

4.2.2.3. Basic Load Data.

This dialog consists of four sub-dialogs that are linked in sequence, with "next", "back", and "finished" buttons to allow the user to navigate through the sequence. Once the user selects "finished" on the final sub-dialog, the program returns to the top level in the SLDA Set-Up Dialog. Basic Load data entries are stored in three tables: Class I Basic Load Data Table, Class III Basic Load Data Table, and Class V Basic Load Data Table.

4.2.2.3.1. Class I Basic Load Data.

This dialog allows the user to select basic load values for Class I supply items. All entries should be integer values. The dialog should allow numeric basic load entries for "MREs per soldier", "Gallons of bulk water per soldier", and "Bottles of water per soldier". Data should be stored in the Class I Basic Load Data Table. The values entered are stored in the Class I Basic Load Data Table. A "next" button should take the user to the "Class III Basic Load Data" dialog.

4.2.2.3.2. Class III Basic Load Data.

This dialog has two sub-dialogs, one for bulk POL products and one for package POL products. POL products data should be stored in a POL Products Table. Information should be presented in tabular form. If device storage limitations can accommodate it, the tables in both sub-dialogs should be pre-populated with POL product data based on the vehicles and equipment currently stored in the Unit Equipment Table. The sub-dialog for bulk POL products should be the first

sub-dialog to appear (it should appear immediately upon entering the "Class III Basic Load Data" dialog). The user then enters the quantities (in gallons) for each bulk POL product type. The user should also be allowed to select additional bulk POL product types and assign quantities if a certain product was not in the pre-populated list. The bulk POL product sub-dialog should have a button that says "Enter package POL basic loads" which takes the user to the package POL basic load sub-dialog. This sub-dialog should be the same as the bulk POL basic load sub-dialog, except that unit of issue should be included in the POL products table. The user selects the number of units for each package POL product type. A provision allowing the user to add additional package POL products and quantities should be implemented in the same manner as the bulk POL basic load sub-dialog. Data from both sub-dialogs should be stored in the Class III Basic Load Data Table. On the package POL basic load sub-dialog, a "next" button should take the user to the "Class V Basic Load Data" dialog. A "back" button should return the user to the "Class I Basic Load Data" dialog.

4.2.2.3.3.   Class V Basic Load Data.

Ammunition products data should be stored in an Ammunition Products Table. Information should be presented in tabular form. If device storage limitations can accommodate it, the tables in the dialog should be pre-populated with ammunition product data based on the vehicles and equipment currently stored in the Unit Equipment Table. The user enters the quantities for each ammunition product type. The user should also be allowed to select additional ammunition product types and assign quantities if a certain product was not in the pre-populated list. Data should be stored in the Class V Basic Load Data Table. A "finished" button should take the user to the top-level dialog. A "back" button should return the user to the "Class III Basic Load Data" dialog.

4.2.2.4.   Planning Values.

This dialog consists of three sub-dialogs that are linked in sequence, with "next", "back", and "finished" buttons to allow the user to navigate through the sequence. Once the user selects "finished" on the final sub-dialog, the program returns to the top level in the SLDA Set-Up Dialog. Planning Value data entries are stored in three tables: the Water Planning Values Table, the POL Planning Values Table, and the Ammo Planning Values Table. The values stored in them represent the default consumption values for these items.

4.2.2.4.1. Enter Water Planning Values Sub-Dialog.

This sub-dialog should allow the user to enter values for water consumption. The values are given in terms of gallons/soldier/day, and depend on the MOPP level and the climate type (Edwards, 2000). The user should be able to input a value for each climate type/MOPP level combination. A button marked "Go to POL Values" should take the user to the "Enter POL Planning Values" sub-dialog.

4.2.2.4.2. Enter POL Planning Values Sub-Dialog.

This sub-dialog should allow the user to enter values for POL product consumption (both bulk fuel and package POL). A button marked "Go to Ammo Values" should take the user to the "Enter Ammo Planning Values" sub-dialog. A "back" button should take the user back to the "Enter Water Planning Values" sub-dialog.

4.2.2.4.3. Enter Ammo Planning Values Sub-Dialog.

This sub-dialog should allow the user to enter values for ammunition product consumption. A button marked "Finished" should take the user back to the top-level dialog. A "back" should take the user back to the "Enter POL Planning Values" sub-dialog.

4.2.3. Functional Requirements.

The SLDA Set-Up dialog will require three read-only tables of information: an Equipment Data Table, a POL Products table, and an Ammunition Products table. Furthermore, four tables that allow read & write functions will be needed: a Unit Equipment Table, a Class I Basic Load Data table, a Class III Basic Load Data table, and a Class V Basic Load Data table.

4.2.3.1. Equipment Data Table.

This table should contain a complete list of all vehicles, systems, and individual weapons that depend on the SLDA's three primary classes of supply (I, III, and V). It will serve as the basis for the Unit Equipment Table. Any equipment that will not be considered for supply forecasting does not need to be included in the table (i.e. the current concept of the SLDA does not consider aviation units, so aircraft do not need to be included in this table). If a weapon system is part of a combat vehicle (i.e. the main gun on an M1 tank), it should be related to that combat vehicle in the table and not listed as a separate system. Individual weapons (like the M16) should be listed

as separate systems. This should be done so that, for example, if 16 M1A1 tanks are entered during set-up, 16 120mm main guns would be automatically included (along with other organic weapons), and they would not need to be entered separately. This table should also indicate, for each vehicle, system, or weapon, what POL or ammunition products are needed for its operation. Data from this table will be read into the Unit Equipment Table based on user input.

4.2.3.2. POL Products Table.

This table should contain a complete list of all bulk and package POL products. It will serve as the basis for the Class III Basic Load Data Table.

4.2.3.3. Ammunition Products Table.

This table should contain a complete list of all ammunition products. It will serve as the basis for the Class V Basic Load Data Table.

4.2.3.4. Unit Equipment Table.

This table contains the list of vehicles, systems, and individual weapons that are actually present in the unit (including attachments & detachments). The information stored here is read from the Equipment Data Table based on user input entered in the Unit Information dialog. Relevant data from this table should be used to pre-populate the sub-dialogs in the Equipment Data dialog in order to speed program set-up. It should also be used to pre-populate the sub-dialogs for POL and ammunition basic loads in the Basic Load Data dialog.

4.2.3.5. Class I Basic Load Data Table.

All information pertaining to the basic loads for meals and water (bulk or bottled) should be stored here.

4.2.3.6. Class III Basic Load Data Table.

All information pertaining to the basic loads for bulk and package POL products should be stored here.

4.2.3.7. Class V Basic Load Data Table.

All information pertaining to the basic loads for ammunition products should be stored here.

4.2.3.8.   Water Planning Values Table.

All default planning values for water products should be stored here. The table should allow for the updating of values based on historical data.

4.2.3.9.   POL Planning Values Table.

All default planning values for POL products (bulk fuel and package POL) should be stored here. The table should allow for the updating of values based on historical data.

4.2.3.10. Ammo Planning Values Table.

All default planning values for ammunition products should be stored here. The table should allow for the updating of values based on historical data.

4.3. Class I Forecasting Dialog.

4.3.1. Description.

This dialog should accept user input personnel counts, MOPP level, and ration cycles. It should consist of four sub-dialogs (presented to the user in sequence): two requiring input (Personnel, MOPP, and Climate Data sub-dialog, and Ration & Water Data sub-dialog), one for input review (Class I Data Review sub-dialog), and one for forecast data (Class I Forecast Data sub-dialog). It should also allow the user to review and adjust on-hand quantities of Class I items. Once the user has the opportunity to review inputs, the dialog should produce a forecast of Class I supplies for the next three re-supply periods. All user inputs and program-generated outputs resulting from this dialog should be placed in an array as they are entered or calculated, and the array should be stored in the Forecast History Table upon exiting the dialog.

4.3.2. Stimulus/Response Sequences.

4.3.2.1.   Personnel, MOPP, and Climate Data sub-dialog.

User selects the number of soldiers assigned to the unit for each of the three re-supply periods, separated by MRE type. Spinners are used to allow the user to change the values for each field. User selects MOPP level for each day included in the next three re-supply periods using pull-down menus (possible inputs are 0, I, II, III, IV, Unknown). User selects climate type for each day included in the next three re-supply periods using pull-down menus (possible inputs are Hot-

Tropical, Hot-Arid, Temperate, and Cold). A button marked "Go to Ration Data" should take the user to the "Ration & Water Data" sub-dialog.

4.3.2.2. Ration & Water Data sub-dialog.

User selects the ration type (using pull-down lists) for each day and each meal included in the next three re-supply periods. MRE and water basic load data should be shown here for user review. On-hand quantities for each type of MRE (in cases) and for water (in gallons) should be shown, and the values should be calculated by taking the previous day's on-hand quantity and subtracting the expected consumption over the last 24 hours. The user should be allowed to change the on-hand quantities, and both the calculated values and the user-entered values should be stored in the array. A button marked "Go to Data Review" should take the user to the "Class I Data Review" sub-dialog. A "back" button should take the user back to the "Personnel, MOPP, and Climate Data" sub-dialog.

4.3.2.3. Class I Data Review sub-dialog.

This sub-dialog is for data review only. On-hand quantities for cases of MREs (by type) and water should be shown. Personnel counts for each day within the next three re-supply periods should be shown, separated by the type of MRE they require. All ration cycles for the next three re-supply period should be shown. MOPP levels and climate types for each day within the next three re-supply period should be shown. A Button marked "Forecast" should take the user to the "Class I Forecast Data" sub-dialog. A "back" button should return the user to the "Ration & Water Data" sub-dialog.

4.3.2.4. Class I Forecast sub-dialog.

The purpose of this dialog is to present the forecast recommendations for Class I items to the user. It should present the forecasts for the next three re-supply periods. Specifically, it should provide a forecast for the number of cases of MREs (by type), rounded up to the nearest integer. It should provide a forecast of other meal types (i.e. hot A's) in terms of individual meals. It should provide a forecast for water requirements, both bulk and bottled. MRE forecast calculations are given in equations 1, 2, 3, and 4 (Appendix C). For water, there are two forecasting methods to be used:

4.3.2.4.1. Forecast based on default planning values.

This is the default method, and will be used any time there is insufficient consumption history, or if consumption does not deviate significantly from the planning values. Planning values for water are given in gallon/soldier/day. Water forecast calculations are given in equations 5, 6, 7, and 8 (Appendix C).

4.3.2.4.2. Forecast based on consumption-adjusted values.

The calculations for this forecast are the same as those based on the default planning values, except that the planning value P will be different. A consumption-adjusted value is substituted for a default planning value if the consumption over a certain period of time is determined to be significantly different from the default value. This is done using the following method:

1. Five forecasts must be generated using the same values for climate and MOPP.
2. From the five forecast records, four consumption rate values are calculated using equation 9.
3. The mean and standard deviation of the four consumption rate values is calculated.
4. A "Student's t" statistic is calculated from this data using equation 10.
5. If the absolute value of the t-statistic determined in step 4 is greater than 3.182, then the mean value calculated in step 3 is substituted for the default planning value.
6. The process starts over (the same test is conducted every time five forecasts are recorded with the same climate and MOPP values).

A button should be provided on this dialog to take the user back to the MFSD.

4.3.3. Functional Requirements.

4.3.3.1. Class I Basic Load Data table.

See paragraph 4.2.2.3.1.

4.3.3.2. Default Consumption Planning Factors Table (Water).

This table contains the planning factors as shown in Edwards, page 66. Entry arguments for the table are MOPP level and climate type.

4.3.3.3. Class I Daily Forecast Record.

This is an array that contains all inputs and outputs relevant to the current forecast (described in section 4.3.2). This is entered as a record in the Class I Forecast History Table. A date/time stamp should be appended to the record.

4.3.3.4. Class I Forecast History Table.

This table contains a copy of each Class I Daily Forecast Record, with the most recent record listed on top.

4.4. Class III Forecasting Dialog.

4.4.1. Description.

This dialog should accept user-input vehicle status (number of deadlined vehicles, by type), mission data (type, duration of phase, terrain), and on-hand quantities data. It should consist of five sub-dialogs (presented to the user in sequence): three requiring input (Vehicle Status Dialog, Mission Data Dialog, and On-Hand Quantities Dialog), one for input review (Class III Data Review sub-dialog), and one for forecast data (Class III Forecast Data sub-dialog). Once the user has the opportunity to review inputs, the dialog should produce a forecast of Class III supplies for the next three re-supply periods. All user inputs and program-generated outputs resulting from this dialog should be placed in an array as they are entered or calculated, and the array should be stored in the Forecast History Table upon exiting the dialog.

4.4.2. Stimulus/Response Sequences.

4.4.2.1. Vehicle Status Sub-Dialog.

User is presented a list of vehicles/systems with an integer field to the right of the nomenclature which is used to indicate the number of deadlined vehicles/systems of that type. Spinners are used to allow the user to change the values for the deadline count. A button marked "Go to Mission Data" should take the user to the "Mission Data" sub-dialog.

4.4.2.2. Mission Data Sub-Dialog.

This sub-dialog should be a dynamic list, which will allow the user to enter as many rows as are needed to account for mission details covering the next three re-supply periods (i.e. for a unit

using a 24-hour re-supply interval, once the time accounted for in the "Mission Duration" field reaches 72 hours, the list is complete). Each row should have a field for "Mission Type" (selections are made from a pull-down list), "Mission Duration" (an integer field controlled by a spinner; duration is entered to the nearest whole hour), and "Mission Terrain" (selections are made from a pull-down list). A check should be made after each row is completed to see if the time durations in the "Mission Duration" column sum to three re-supply periods. If not, another row is presented requiring user input. A new record is needed if either the mission type or mission terrain changes (i.e. no two consecutive records should share the same values for mission type and mission terrain). The list should be scrollable if the number of rows exceeds the size of the window. A button marked "Go to On-Hand Quantities" should take the user to the "Class III On-Hand Quantities" sub-dialog. A "back" button should take the user back to the "Vehicle Status" sub-dialog.

4.4.2.3. Class III On-Hand Quantities Sub-Dialog.

This sub-dialog should present the user with two scrollable lists of POL products – one list for bulk POL products and the other for package POL products. The items in each list should be based on the POL products stored in the "Class III Basic Load Data Table". Each row should display fields identifying the POL product and the unit of issue, and an integer field that allows the user to enter or change the on-hand quantities. A button marked "Go to Data Review" should take the user to the "Class III Data Review" sub-dialog. A "back" button should take the user back to the "Mission Data" sub-dialog.

4.4.2.4. Class III Data Review Sub-Dialog.

This sub-dialog is for data review only, and is presented in a scrollable window. Only vehicles or systems that have one or more deadline indicated for their type should be shown (this list only needs to show the nomenclature and the deadline count). The mission data and on-hand quantities can be shown as they were entered. A Button marked "Forecast" should take the user to the "Class III Forecast Data" sub-dialog. A "back" button should return the user to the "Class III On-Hand Quantities" sub-dialog.

4.4.2.5. Class III Forecast Sub-Dialog.

The purpose of this dialog is to present the forecast recommendations for Class III items to the user. It should present the forecasts for the next three re-supply periods. Specifically, it should provide a forecast for the quantity of each type of bulk fuel and package POL products.

4.4.3. Functional Requirements.

4.4.3.1. Class III Basic Load Data Table.

See paragraph 4.2.2.3.2.

4.4.3.2. Default Consumption Planning Factors Table (POL Products).

This table contains consumption planning values and entry arguments for POL products that are needed for the vehicles and systems stored in the Unit Equipment Table.

4.4.3.3. Class III Daily Forecast Record.

This is an array that contains all inputs and outputs relevant to the current forecast (described in section 4.4.2). This is entered as a record in the Class III Forecast History Table. A date/time stamp should be appended to the record.

4.4.3.4. Class III Forecast History Table.

This table contains a copy of each Class III Daily Forecast Record, with the most recent record listed on top.

4.5. Class V Forecasting Dialog.

4.5.1. Description.

This dialog should accept user-input weapon status (number of deadlined weapons, by type), and should reflect vehicle status entered in the Class III Forecasting Dialog as it relates to weapons status (i.e. if a weapon would be considered deadlined because its prime mover is deadlined, that information should be presented to the user). It should use the same mission data that was entered in the Class III Forecasting Dialog. It should accept on-hand ammunition quantities data. It should consist of five sub-dialogs (presented to the user in sequence): three requiring input

(Weapon Status Dialog, Mission Data Dialog, and On-Hand Quantities Dialog), one for input review (Class V Data Review sub-dialog), and one for forecast data (Class V Forecast Data sub-dialog). Once the user has the opportunity to review inputs, the dialog should produce a forecast of Class V supplies for the next three re-supply periods. All user inputs and program-generated outputs resulting from this dialog should be placed in an array as they are entered or calculated, and the array should be stored in the Forecast History Table upon exiting the dialog.

4.5.2. Stimulus/Response Sequences.

4.5.2.1. Weapons Status Sub-Dialog.

User is presented a list of weapons with an integer field to the right of the nomenclature which is used to indicate the number of deadlined weapons of that type. If a weapon is deadlined because of its prime mover, the dialog should indicate this to the user. Spinners are used to allow the user to change the values for the deadline count. A button marked "Go to Mission Data" should take the user to the "Mission Data" sub-dialog.

4.5.2.2. Mission Data Sub-Dialog/Review.

This data is entered by the user in the Class III Forecast Dialog, and should be presented to the user here for review. The list should be scrollable if the number of rows exceeds the size of the window. A button marked "Go to On-Hand Quantities" should take the user to the "Class V On-Hand Quantities" sub-dialog. A "back" button should take the user back to the "Weapons Status" sub-dialog.

4.5.2.3. Class V On-Hand Quantities Sub-Dialog.

This sub-dialog should present the user with a scrollable list of ammunition products. The items in the list should be based on the ammunition products stored in the "Class V Basic Load Data Table". Each row should display fields identifying the ammunition product and the unit of issue, and an integer field that allows the user to enter or change the on-hand quantities. A button marked "Go to Data Review" should take the user to the "Class V Data Review" sub-dialog. A "back" button should take the user back to the "Mission Data" sub-dialog.

4.5.2.4. Class V Data Review Sub-Dialog.

This sub-dialog is for data review only, and is presented in a scrollable window. Only weapons that have one or more deadline indicated for their type should be shown (this list only needs to show the nomenclature and the deadline count). The mission data and on-hand quantities can be shown as they were entered. A Button marked "Forecast" should take the user to the "Class V Forecast Data" sub-dialog. A "back" button should return the user to the "Class V On-Hand Quantities" sub-dialog.

4.5.2.5. Class V Forecast Sub-Dialog.

The purpose of this dialog is to present the forecast recommendations for Class III items to the user. It should present the forecasts for the next three re-supply periods. Specifically, it should provide a forecast for the quantity of each type of bulk fuel and package POL products.

4.5.3. Functional Requirements.

4.5.3.1. Class V Basic Load Data Table.

See paragraph 4.2.2.3.3.

4.5.3.2. Default Consumption Planning Factors Table (Ammunition Products).

This table contains consumption planning values and entry arguments for ammunition products that are needed for the weapons stored in the Unit Equipment Table.

4.5.3.3. Class V Daily Forecast Record.

This is an array that contains all inputs and outputs relevant to the current forecast (described in section 4.5.2). This is entered as a record in the Class V Forecast History Table. A date/time stamp should be appended to the record.

4.5.3.4. Class V Forecast History Table.

This table contains a copy of each Class V Daily Forecast Record, with the most recent record listed on top.

4.6. Requisition & Report Generation Dialog.

Although there is interest at the unit level regarding the ability to generate supply requisitions with the SLDA, the development of this capability is beyond the scope of this phase of

development. Also, there was no discussion with stakeholders on the type or format of reports. It is assumed that part of the SLDA's further development will eventually include both of these capabilities, so a provision should be made to accommodate these functions in the future.

Chapter 5:   Other Non-Functional Requirements.

5.1. Security Requirements.

Determined by PM-LIS/TLDD

5.2. Special User Requirements.

5.2.1.   Backup and Recovery.

Since the normal method of back-up and data recovery for a PDA-type device involves the identification and synchronization with a "parent" computer system, it is assumed that the SLDA will perform these functions in a similar manner. The exact method of synchronization (direct connection, wireless) will be determined by PM-LIS/TLDD. The parent computer can be used to store the complete transaction and forecast history from the SLDA if it becomes necessary to truncate the historical records stored in the SLDA due to limited memory or storage. The SLDA should be able to recover its last known state from the parent computer through the synchronization connection.

5.2.2.   Data Retention.

The only tables that will increase in size during operation of the SLDA are the forecast history tables. They should retain the minimum amount of data necessary for forecasting based on historical data, and previous records can be archived on the parent computer as described in paragraph 5.2.1.

5.2.3.   User Training.

Determined by PM-LIS/TLDD.

Chapter 6:   Future Development.

6.1. Validate and Verify Class I Forecasting Approach.

The method of basing a Class I forecast on planning values determined from actual data needs to be tested through actual experience. The published planning values have long been used as a basis for forecasting supply needs, but since the SLDA makes use of historical data once enough data has been recorded, its results should be evaluated through field testing to determine if the approach works.

6.2. Develop historical data forecasting for Classes III and V.

If the approach used for Class I is valid, a similar method could be explored for Classes III and V. Also, planning values for Class III package and Class V could be incorporated to allow the same method used for Class I to be employed for the other classes (as shown in Figure 4 and Figure 5).

6.3. Resource Planning.

Another aspect of logistics planning at certain levels is transportation planning. A further development for the SLDA could include a means of determining whether the requested supplies can be transported with available assets, or if a request must be made for additional support.

6.4. Automated Requisitioning.

As previously noted, future SLDA development could include the ability to turn the forecast output into an automated requisition. It was assumed that this task would be handled by a separate application, but that the SLDA would provide the necessary data objects to be used by an automated requisition application.

Appendix A: SLDA Diagrams
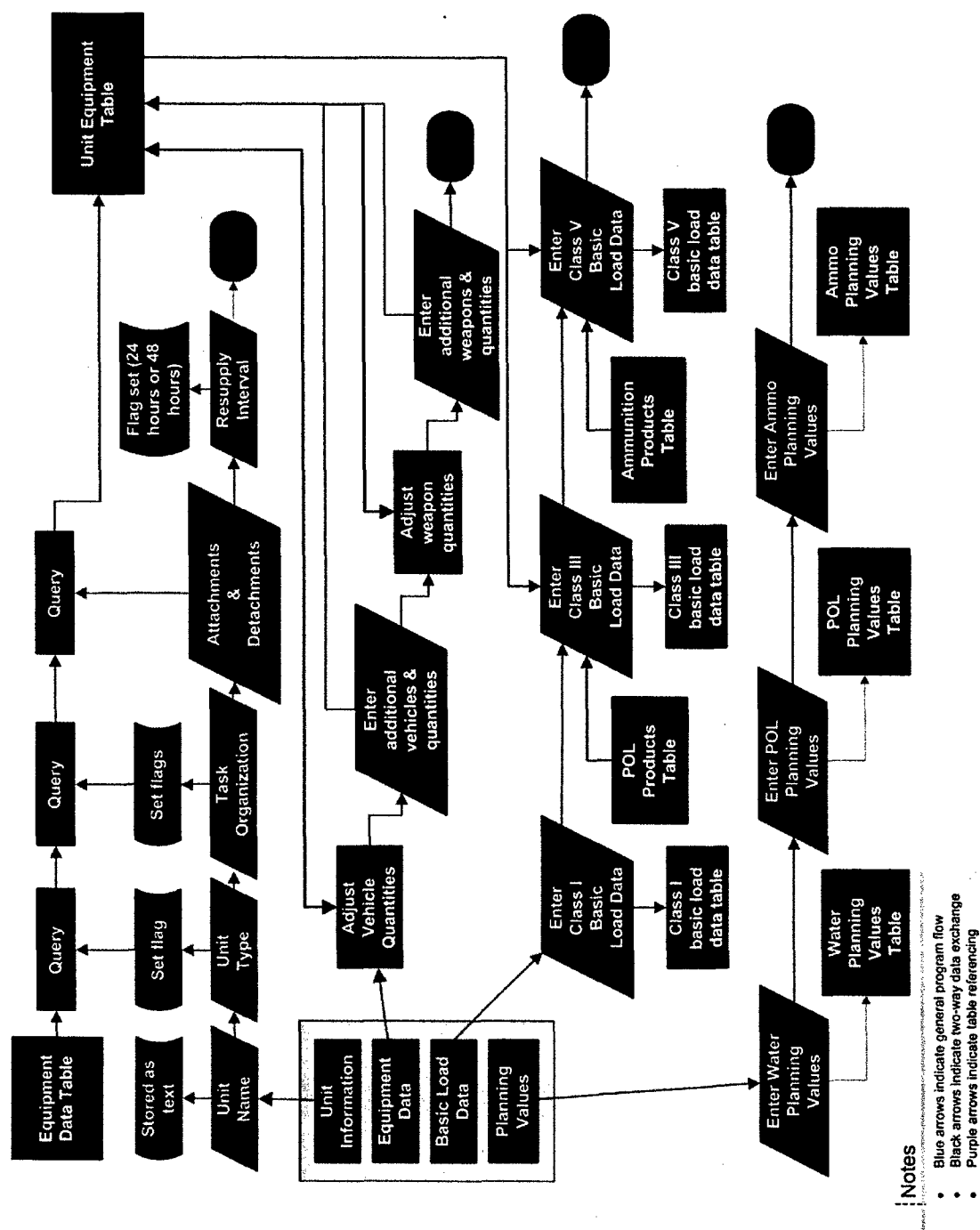
Figure 2: Diagram of Set-Up Dialog

Process Notes

This process will be done for each 24-hour period within the next three re-supply cycles (24-hour re-supply interval requires 24, 48, and 72 hour inputs; 48-hour re-supply interval requires 24, 48, 72, 96, 120, 144 hour inputs)

Input ration cycles

Verify or adjust on-hand MRE quantities

Verify or adjust on-hand water quantities

Input number of soldiers for each MRE type

Input MOPP level

Personnel Data, MOPP & Climate Data Dialog

Ration & Water Data Dialog

Class I Basic Load Data Table

Data Review

Historical Data Table

Class I Daily Forecasting Record (inputs and outputs)

Compute Class I Forecast

Default Consumption Planning Factors Table (water)

Forecast Data

Return

Figure 3: Diagram of Class I Forecast Dialog

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Process Notes

In the event-based mission record step, a record is created whenever mission type or mission terrain changes. Records are created until the time included in the next three re-supply cycles is accounted for.
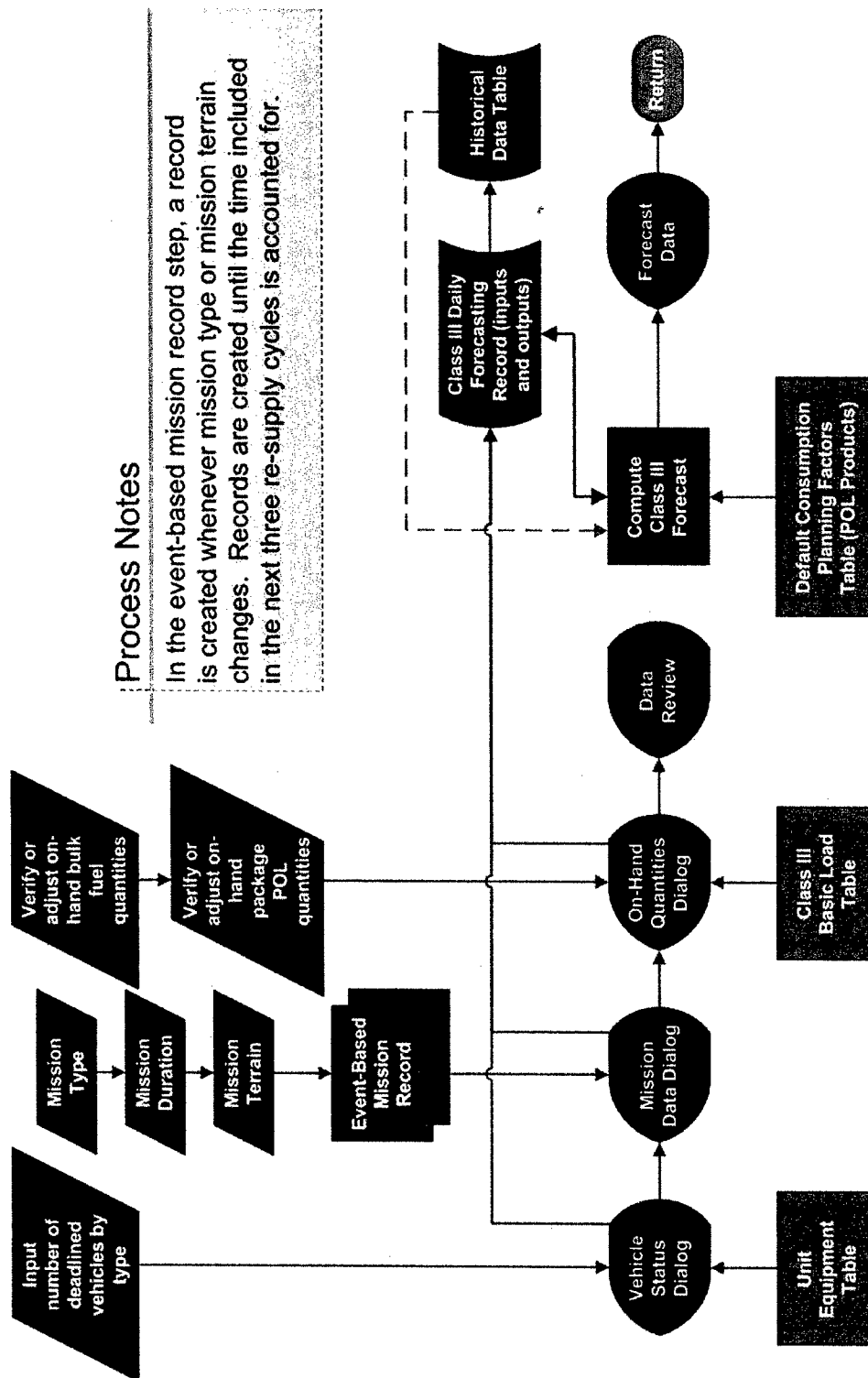
Figure 1: Diagram of Class III Forecast Dialog

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Process Notes

In the event-based mission record step, a record is created whenever mission type or mission terrain changes. Records are created until the time included in the next three re-supply cycles is accounted for.

Figure 2: Diagram of Class V Forecast Dialo

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Appendix B: Functional Hierarchy

1.0 Receive relevant inputs

    1.1 Set default inputs

        1.1.1   Unit information

                1.1.1.1 Name

                1.1.1.2 Type

        1.1.2   Local time and date (from system or entered as difference from GMT)

        1.1.3   Equipment

                1.1.3.1 Vehicles (quantities by type)

                1.1.3.2 Weapons (those not integral to vehicles in 1.1.3.1)

                1.1.3.3 Advanced functions
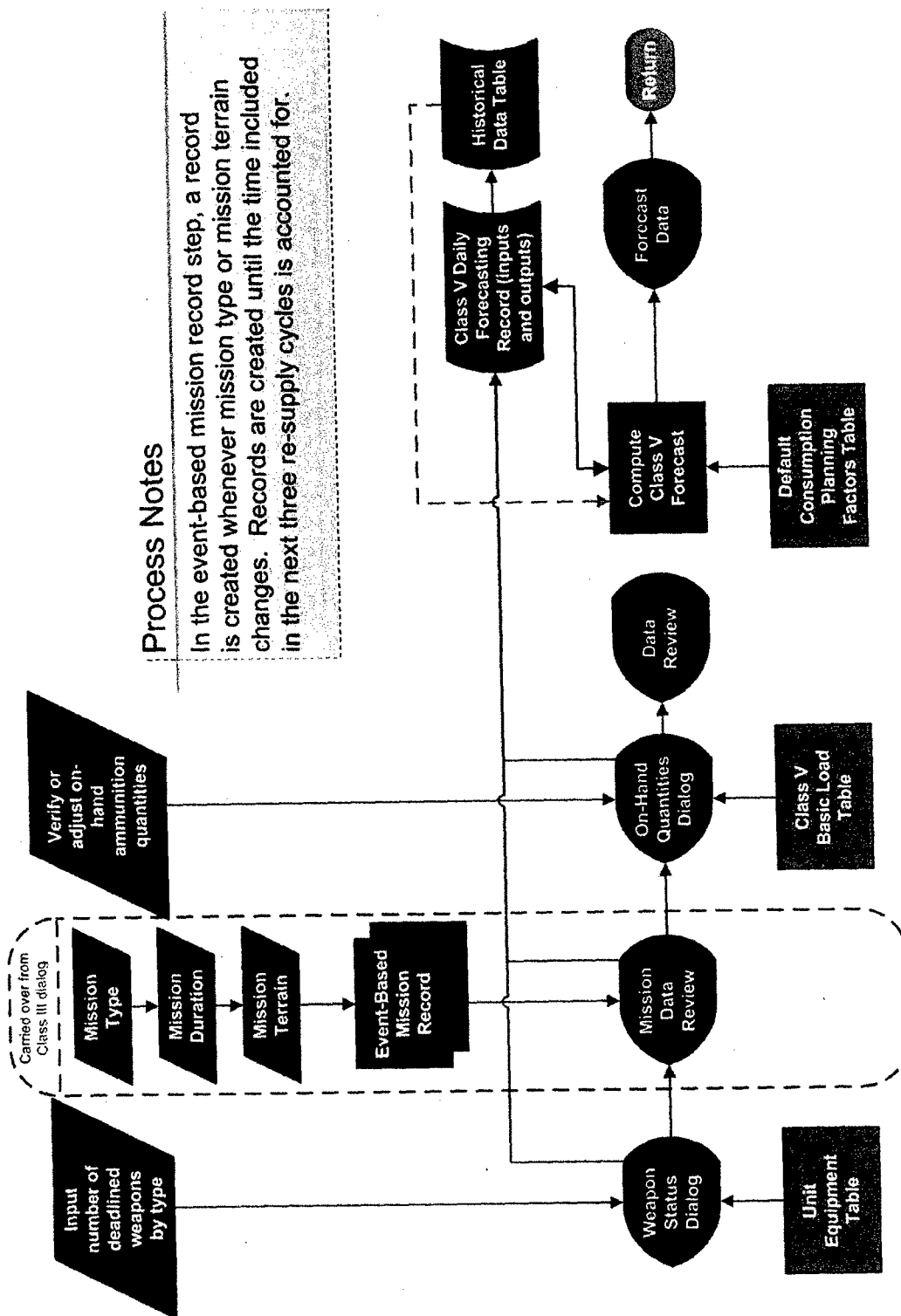
                        1.1.3.3.1   Change default consumption factors

        1.1.4   Basic Load Data

        1.1.5   Re-supply interval (24 or 48 hours)

    1.2 Dynamic inputs

        1.2.1   Personnel status

                1.2.1.1 Total personnel counts & counts of personnel with special meal requirements, covering three re-supply periods

                1.2.1.2 Ration cycles for next three re-supply periods

        1.2.2   Mission Data (Dynamic list containing the following elements. A new entry is started if one of the elements changes. Should always reflect mission details for the next three re-supply periods)

                1.2.2.1 Time of event

                1.2.2.2 Mission type (offensive, defensive, movement)

                1.2.2.3 Mission terrain (cross-country, road, idle)

                1.2.2.4 MOPP level

        1.2.3   Current equipment and supplies status

                1.2.3.1 Deadlined equipment

                        1.2.3.1.1   Pacing items

                        1.2.3.1.2   Rolling Stock

                        1.2.3.1.3   Other

                1.2.3.2 On-hand supplies

                        1.2.3.2.1   Class I (rations and water)

                        1.2.3.2.2   Class III (bulk and package petroleum products)

                        1.2.3.2.3   Class V (ammunition)

2.0 Provide forecasts for next three re-supply operations

    2.1 Class I

        2.1.1   MREs by type (quantities for individual meals and for cases)

        2.1.2   Hot A's and unitized groups rations (UGR) by number of meals

        2.1.3   Water, bulk

        2.1.4   Water, bottled

    2.2 Class III

        2.2.1   Bulk fuel

        2.2.2   Package POL

    2.3 Class V

3.0 Generate requisitions and reports

    3.1 Requisitions

        3.1.1   Class I

        3.1.2   Class III

        3.1.3   Class V

    3.2 Reports (review, edit, send)

        3.2.1   Reports to next higher echelon

        3.2.2   Report to SPO

    3.3 Historical reports

Appendix C: Equations

1. MRE forecast (each MRE type), 24-hour re-supply interval, next day (D+1):

$$F_{MRE} = \left\lceil \frac{S_{D+1} \cdot R_{D+1}}{C} \right\rceil + B_{MRE}\left(S_{D+1} - H_{D+0}\right)$$

2. MRE forecast (each MRE type), 48-hour re-supply, next two days:

$$F_{MRE} = \left\lceil \frac{S_{D+1} \cdot R_{D+1}}{C} \right\rceil + B_{MRE}\left(S_{D+1} - H_{D+0}\right) + \left\lceil \frac{S_{D+2} \cdot R_{D+2}}{C} \right\rceil$$

3. MRE forecast (each MRE type), 24-hour re-supply, D+2 and D+3:

$$F_{MRE} = \left\lceil \frac{S_{D+k} \cdot R_{D+k}}{C} \right\rceil \text{ for } k = 2,3$$

4. MRE forecast (each MRE type), 48-hour re-supply, D+3 through D+6:

$$F_{MRE} = \left\lceil \frac{S_{D+k} \cdot R_{D+k}}{C} \right\rceil + \left\lceil \frac{S_{D+(k+1)} \cdot R_{D+(k+1)}}{C} \right\rceil \text{ for } k = 3,5$$

5. Water forecast (default planning value), 24-hour re-supply interval, next day (D+1):

$$W = S_{T_{D+1}} \cdot P_{(\text{Climate, MOPP})_{D+1}} + B_W\left(S_{T_{D+1}} - H_{W_{D+0}}\right)$$

6. Water forecast (default planning value), 48-hour re-supply interval, next two days:

$$W = S_{T_{D+1}} \cdot P_{(\text{Climate, MOPP})_{D+1}} + B_W\left(S_{T_{D+1}} - H_{W_{D+0}}\right) + S_{T_{D+2}} \cdot P_{(\text{Climate, MOPP})_{D+2}}$$

7. Water forecast (default planning value), 24-hour re-supply interval, D+2 and D+3:

$$W = S_{T_{D+k}} \cdot P_{(\text{Climate, MOPP})_{D+k}} \text{ for } k = 2,3$$

8. Water forecast, (default planning value), 48-hour re-supply interval, D+3 through D+6:

$$W = S_{T_{D+k}} \cdot P_{(\text{Climate, MOPP})_{D+k}} + S_{T_{D+(k+1)}} \cdot P_{(\text{Climate, MOPP})_{D+(k+1)}}, \text{ for } k = 3,5$$

9. Water consumption rate:

$$\rho_{n-1} = \frac{W_n + \left(H_n - H_{n-1}\right)}{S_{T_{n-1}}}, \text{ where } n \text{ represents the current day}$$

10. Student's t statistic for water forecasting:

$$t_{Water} = \frac{\left(\bar{\rho} - P_{Climate, MOPP}\right)}{\left(\sigma_{\rho}/3\right)},$$ where $P_{Climate, MOPP}$ is the planning figure

being tested, $\bar{\rho}$ is the mean of the four calculated water consumption rates, and σ_{ρ} is the standard deviation of the four calculated water consumption rates.

Legend:

S_i : the number of soldiers (by MRE type) assigned on day i

R_i : the number of MREs in the ration cycle on day i

C : the number of MREs per case

B_k : basic load for item k

H_{k_i} : on - hand quantity for item k on day i

P : planning value

S_T : total number of soldiers

$\lceil \ \rceil$ is intended to represent a ceiling function (round up to nearest integer)

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14. ABSTRACT

Currently, there is no standard tool designed to assist Army maneuver battalions in daily forecasting of food, water, petroleum products, and ammunition. Support platoon leaders and battalion logistics officers forecast logistical requirements primarily by hand or with tools developed "in-house". Because these personnel do not get the training needed to do accurate forecasting, they typically seek the assistance of Forward Support Battalion (FSB) company commanders through informal channels. The goal is to achieve the most accurate supply forecast possible, but under the current system, over-forecasting or under-forecasting is common, which can result in unnecessary risk to the mission, units, or support personnel, as well as increasing stress on the logistics chain. Currently, the only automated tools available are designed for brigade level and above.

The Support Leader's Digital Assistant (SLDA) began as an Excel spreadsheet designed to forecast re-supply needs based on existing planning figures, and was subsequently developed for the Palm platform as a test of concept. The goal of this phase of development was to expand its forecasting capabilities, adjust the model's parameters to interface with existing, higher echelon automated systems, and to facilitate its development for the PocketPC platform.

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